

Nutrient limitation of periphyton in Idaho streams: results from nutrient diffusing substrate experiments

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Abstract. Many streams and rivers in the Pacific Northwest of the US are inherently oligotrophic, and primary production in these ecosystems is assumed to be nutrient-limited. In many of these streams, reductions in the amount of marine-derived nutrients delivered by spawning salmonids could be exacerbating the degree of oligotrophication. To test whether primary producers are nutrient-limited, nutrient diffusing substrate (NDS) experiments were used to measure algal responses to amendments of N, P, and a combination of N and P (N+P) in 13 Salmon River basin streams in central Idaho, USA. Thirty-eight experiments were conducted between 2003 and 2006 to determine whether nutrient limitation varied among streams and over time within individual streams. Primary producers in most streams showed some form of nutrient limitation. Thirty-nine percent of our experiments suggested N and P colimitation, 18% suggested N limitation, 11% suggested primary N and secondary P limitation, and 32% did not indicate limitation by either N or P. The type of nutrient limitation within individual streams varied with time, and the relative importance of N or P changed seasonally or annually in 7 of the 13 streams. Algal accrual rates on control and treatment substrates were most strongly predicted by water temperature, light, and ambient concentrations of N and P. Among all of the experiments, algal accrual rates were greater on N substrates in streams with lower ambient N concentrations and greater ambient P concentrations. Our results suggest that a combination of N and P typically limits primary producers in these streams. Our efforts to characterize current nutrient limitation in these streams will be of value to managers considering nutrient additions as a tool to improve stream productivity to benefit threatened and endangered salmonids.

Key words: nutrient limitation, stream, nutrient diffusing substrate, nitrogen, phosphorus.